although it is less marked than in the case of the hollow cylinders, as might have been expected.

The tendency of the cooled skin of a heated metallic mass to squeeze out its contents appears to be what gives rise to the bulging seen near the water-line in the hollow cylinder of brass. Wrought iron, being highly tenacious even at a comparatively high temperature, resists with great force the sliding motion of the particles which must take place in order that the tendency of the cooled skin to squeeze out its contents may take effect; but brass, approaching in its hotter parts more nearly to the state of a molten mass, exhibits the effect more strongly. It seems probable that even in the case of brass a *very* thin hollow cylinder would exhibit a contraction just above the water-line. Should there be a metal or alloy which about the temperatures with which we have to deal was stronger hot than cold, the effect of the cause first referred to would be to produce an expansion a little below the water-line.—G. G. S.]

March 12, 1863.

Dr. WILLIAM ALLEN MILLER, Treasurer and Vice-President, in the Chair.

His Grace the Archbishop of York was admitted into the Society.

The following communications were read:—

I. "On the Influence of Temperature on the Electric Conducting Power of Thallium and Iron." By A. MATTHIESSEN, F.R.S., and C. VOGT, Ph.D. Received February 12, 1863.

(Abstract.)

Thallium.—The experiments detailed in this paper were made with specimens of thallium lent to us by Mr. Crookes and Professor Lamy of Lille. The values obtained for the conducting power, together with the formulæ for the correction of the conducting power for temperature of the different specimens, were:—

For Mr. Crookes's metal,

1st wire.	2nd wire at 0°.
$\lambda = 9{\cdot}364 - 0{\cdot}037936t + 0{\cdot}00008467t^2$;	9·169.

For M. Lamy's first specimen,

	2nd wire at 0°.	3rd wire.
$\lambda=9{\cdot}419-0{\cdot}039520t+0{\cdot}00009656t^2$;	9·082;	9·223.

Second specimen,

	2nd wire at 0°.
$\lambda=9{\cdot}054-0{\cdot}034697t+0{\cdot}00006554t^2$;	9·226;

or as mean of all the determinations, some of which are not given here,

$$\lambda=9{\cdot}163-0{\cdot}036894t+0{\cdot}00008104t^2.$$

The conducting power of thallium therefore decreases between 0° and 100° 31·420 per cent., which is a larger percentage decrement than that obtained for many other pure metals, namely 29·307 per cent.*

Iron.—The specimens of iron experimented were, with two exceptions, lent us by Dr. Percy. In the following Table we give the results obtained with them :—

(1.) Electrotype iron, deposited from solution of pure sulphate of iron. The strips were very thin and porous; we could not therefore obtain concordant values for the conducting power, but we were able to determine the percentage decrement in the conducting power between 0° and 100°. We have, for the above reason, taken the first observed conducting power equal 100.

$$\lambda=100-0{\cdot}51182t+0{\cdot}0012915t^2,$$

corresponding to a percentage decrement of 38·262 per cent.

(2.) No. 1, annealed and cooled in hydrogen.

$$\lambda=100-0{\cdot}51894t+0{\cdot}0013415t^2,$$

corresponding to a percentage decrement of 38·479 per cent.

(3.) Electrotype iron, a strip cut from the same foil as No. 1.

$$\lambda=100-0{\cdot}51355t+0{\cdot}0013221t^2,$$

corresponding to a percentage decrement of 38·134 per cent.

(4.) No. 3, annealed in air.

$$\lambda=100-0{\cdot}50895t+0{\cdot}0002735t^2,$$

corresponding to a percentage decrement of 38·160 per cent.

(5.) This, as well as Nos. 6, 7, 8, were specimens of iron which have been analysed. They were all hard drawn.

$$\lambda=15{\cdot}719-0{\cdot}074370t+0{\cdot}0001763t^2,$$

corresponding to a percentage decrement of 36·070 per cent.

* Phil. Trans. 1862, Part I.

(6.) $\lambda = 15{\cdot}672 - 0{\cdot}074045t + 0{\cdot}0001761t^2$,

corresponding to a percentage decrement of 36·010 per cent.

(7.) $\lambda = 14{\cdot}269 - 0{\cdot}064133t + 0{\cdot}0001456t^2$,

corresponding to a percentage decrement of 34·742 per cent.

(8.) $\lambda = 12{\cdot}342 - 0{\cdot}055894t + 0{\cdot}0001379t^2$,

corresponding to a percentage decrement of 34·117 per cent.

(9.) Strip of iron, heated in a current of hydrogen at a red heat for two hours. This, as well as Nos. 10, 11, 12, were hardened.

$\lambda = 14{\cdot}673 - 0{\cdot}067999t + 0{\cdot}0001597t^2$,

corresponding to a percentage decrement of 35·459 per cent.

(10.) As No. 9, heated for three hours under sugar charcoal in a current of hydrogen; the carbon taken up was 0·99 per cent.

$\lambda = 10{\cdot}654 - 0{\cdot}044560t + 0{\cdot}00009789t^2$,

corresponding to a percentage decrement of 32·637 per cent.

(11.) As No. 9, heated for four hours under sugar charcoal in a current of hydrogen; the carbon taken up was 0·933 per cent.

$\lambda = 9{\cdot}925 - 0{\cdot}040097t + 0{\cdot}00009168t^2$,

corresponding to a percentage decrement of 31·163 per cent.

(12.) As No. 9, heated for three hours under sugar charcoal in a current of hydrogen; the carbon taken up was 1·06 per cent.

$\lambda = 9{\cdot}457 - 0{\cdot}037573t + 0{\cdot}00008642t^2$,

corresponding to a percentage decrement of 30·592 per cent.

(13.) Thin music wire, melted with one quarter of its weight of peroxide of iron under a flux of plate glass.

$\lambda = 13{\cdot}381 - 0{\cdot}056829t + 0{\cdot}0001230t^2$,

corresponding to a percentage decrement of 33·278 per cent.

(14.) A piece of narrow watch-spring.

$\lambda = 8{\cdot}565 - 0{\cdot}029099t + 0{\cdot}00005383t^2$,

corresponding to a percentage decrement of 27·689 per cent.

(15.) Commercial iron wire.

$\lambda = 13{\cdot}772 - 0{\cdot}058970t + 0{\cdot}0001242t^2$,

corresponding to a percentage decrement of 33·801 per cent.

From the results obtained, it is obvious that the higher the conducting power the higher the percentage decrement in the conducting power between 0° and 100°. This has been proved to be the case with about 100 alloys with which we have experimented. We have also found that we may deduce the conducting power of a pure metal from an impure one when the impurity does not reduce the conducting

power more than, say, 10 to 20 per cent. According to our experiments, the percentage decrement in the conducting power of an impure metal between 0° and 100° varies in the same ratio as the conducting power of the impure metal at 100°, compared with that of the pure metal at 100°.

Thus, from specimens Nos. 5, 6, 7, 9, 13, and 15, the conducting power of pure iron was found to be at 0°=16·725.

In conclusion, we give the values found for specimens of cobalt and nickel wire lent to us by Professor Wöhler. They were as follows:—

Cobalt wire.

$$\lambda=12{\cdot}930-0{\cdot}035521t+0{\cdot}00004887t^2,$$

corresponding to a percentage decrement of 23·692 per cent.

Nickel wire.

$$\lambda=12{\cdot}222-0{\cdot}040787t+0{\cdot}000\ 7088t^2,$$

corresponding to a percentage decrement of 27·573 per cent.

Although these metals were said to be chemically pure, the results obtained seem to indicate that they are not so, having probably taken up some impurities in the process of fusion.

The following Table of the conducting powers of pure metals shows the place which the metals treated of in this paper take in the series.

	Conducting power at 0°.
Silver (hard drawn)	100·00
Copper (hard drawn)	99·95
Gold (hard drawn)	77·96
Zinc	29·02
Cadmium	23·72
Cobalt *	17·22
Iron * (hard drawn)	16·81
Nickel *	13·11
Tin	12·36
Thallium	9·16
Lead	8·32
Arsenic	4·76
Antimony	4·62
Bismuth	1·245

* Probable value for the pure metal deduced from the observations with the impure one.